

COSEWIC Assessment and Status Report

on the

Pygmy Snaketail *Ophiogomphus howei*

in Canada



**SPECIAL CONCERN
2008**

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada



COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

COSEWIC. 2008. COSEWIC assessment and status report on the Pygmy Snaketail *Ophiogomphus howei* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 34 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Production note:

COSEWIC acknowledges Paul M. Brunelle for writing the provisional status report on the Pygmy Snaketail *Ophiogomphus howei* prepared under contract with Environment Canada. The contractor's involvement with the writing of the status report ended with the acceptance of the provisional report. Any modifications to the status report during the subsequent preparation of this report were overseen by Dr. Paul Catling, Co-chair of the COSEWIC Arthropods Specialist Subcommittee.

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Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur l'ophiogompe de howe (*Ophiogomphus howei*) au Canada.

Cover illustration:

Pygmy Snaketail — Provided by the report writer, Paul M. Brunelle.

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Catalogue No. CW69-14/542-2009E-PDF

ISBN 978-1-100-12411-7



Recycled paper



COSEWIC Assessment Summary

Assessment Summary – November 2008

Common name

Pygmy Snaketail

Scientific name

Ophiogomphus howei

Status

Special Concern

Reason for designation

This globally rare species is known from few locations and has a specialized and restricted habitat with low population numbers and one significant site is threatened.

Occurrence

Ontario, New Brunswick

Status history

Designated Special Concern in November 2008. Assessment based on a new status report.



COSEWIC
Executive Summary

Pygmy Snaketail
Ophiogomphus howei

Species information

The Pygmy Snaketail (*Ophiogomphus de Howe**, *Ophiogomphus howei*) is the smallest of a group of species that are characteristic of fast moving water. Even the largest species in this group are of only medium size for North American dragonflies (Anisoptera). The genus is in the Clubtail family (Gomphidae). There are no proposed subspecies or forms.

The adult appearance is typical of the genus except in size and wing markings. Their colour is black with vivid yellow markings on the abdomen and bright green on the thorax. The wings of both sexes are strongly marked basally with a large, transparent yellow-orange field. This is unique in the Clubtails, and rare among North American Odonata in general.

The larvae are small and cryptic, though readily determined in later stadia by the absence of dorsal abdominal hooks. Exuviae (skins abandoned after emergence) are the most often found evidence of the species.

Distribution

The Pygmy Snaketail is largely confined to eastern North America. It is known in a line along the Appalachian Mountains from northern New Brunswick to southeast Tennessee. There is an apparently disjunct centre of distribution of the species in Michigan, Minnesota, Wisconsin and northwestern Ontario.

There are 12 known locales for the species in Canada. Canadian locations are in New Brunswick (11) and Ontario (1). It was first reported for Canada from the banks of the Saint John River in northern New Brunswick in 2002. The US border sites are on the St. Croix River in southwest New Brunswick. It also occurs on the Magaguadavic, Miramichi and Salmon Rivers.

Habitat

The species has been observed laying eggs in smooth-flowing reaches of otherwise tumultuous rivers, and the larval skins from which the adults emerge are commonly found on the erosional banks. This suggests that the larvae live on or within fine sand or pea gravel substrate where the current is strong. Searches for larval skins at many seemingly appropriate waters, and at the appropriate time of the year, have generally yielded no results for the species. It is believed to be absent from these waters; suggesting that the habitat, including factors influencing larval success and emergence locale, should be more narrowly defined than we currently realize.

Biology

As with all dragonflies, larvae and adults are predaceous, principally eating invertebrates. Larvae may also take small fish. There is no firm evidence of the length of time required for the larvae to develop to emergence; however, it is believed to take at least two years.

Emergence is largely associated with the synchronous emergence of other members of its genus. In 2002, emergence on the Saint John River in northern New Brunswick was on June 22, and was accompanied by emergence of several other Snaketails. In southwest New Brunswick, emergence is more likely near the beginning of the second week of June. It is likely that the adults fly for six to eight weeks following emergence, although some individuals survive for a few more weeks.

The adults are rarely encountered at water and are usually difficult to identify in flight. It is likely that they spend much of their flight in the canopy of the forest, which is the case with most Snaketails.

Population sizes and trends

Only 102 individuals of the Pygmy Snaketail have been confirmed in Canada, 101 in New Brunswick and 1 in Ontario. Population size is unknown, but several hundreds of individuals are likely necessary to sustain a population. The data in hand is insufficient to speculate on fluctuation of population.

Given the relatively good condition of the Saint John River at Baker Brook where the Pygmy Snaketail was encountered, and the lack of recent heavy impact on rivers in the region, it is likely but unproven that the Canadian population is stable at its current level.

Limiting factors and threats

Larvae of this species require clear, rapid, and unpolluted running waters, with the appropriate substrate believed to be fine sand or pea gravel. They usually occur in large rivers. Dam construction is a threat to the Ontario population but less of a threat to the New Brunswick populations. Water pollution due to excessive nutrient input from sewage, or sedimentation due to agricultural or forestry run-off are distinct threats to larval habitat. Pesticides and herbicides are also potentially threatening. Invasive species can alter the biota to the detriment of the Pygmy Snaketail.

Special significance of the species

This species' presence is indicative of reasonably uncompromised running waters habitats. It is considered rare or at risk, and a protection priority, throughout its range. Organized and widespread inventory of dragonflies has occurred over the past two decades in both New Brunswick and Ontario, the only provinces in which it is recorded, with the results of this work indicating that it is very rare in both provinces.

Existing protection or other designations

Of the 12 confirmed sites in Canada, the St. Croix River in southwest New Brunswick is protected to some extent by the St. Croix International Waterway Commission. Much of the Miramichi River is managed as a salmon fishery, which protects the habitat of this pristine river. The Saint John River and Magaguadavic River have no formal protection.



COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2008)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.



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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

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SPECIES INFORMATION

Name and classification

Kingdom Animalia-Animal, animals, animaux
Phylum Arthropoda-arthropodes, arthropods, Artrópode
Subphylum Hexapoda-hexapods
Class Insecta-hexapoda, insectes, insects, inseto
Subclass Pterygota-insects ailés, winged insects
Infraclass Palaeoptera-ancient winged insects
Order Odonata Fabricius, 1793-damselflies, dragonflies, libélula
Suborder Anisoptera Selys, 1854-dragonflies, libellules
Family Gomphidae-clubtails, Clubtails
Genus *Ophiogomphus* Selys, 1854
Species *Ophiogomphus howei* Bromley, 1924-Pygmy Snaketail

Ophiogomphus howei Bromley 1924 is a Snaketail (*Ophiogomphus*) Dragonfly, an insect of the suborder Dragonflies (Anisoptera), Clubtail family (Gomphidae).

The species is distinct, with no close relatives, and there are no proposed subspecies or species forms. The genus has been taxonomically stable since its description by Selys Longchamps (1854). Carle (1986, 1992) proposed three subgenera; with the Pygmy Snaketail falling into the subgenus *Ophionuroides*. The species is considered native in all places where it occurs and does not appear to be expanding its range.

The original description was of an adult female, with the presumptive male (correctly) being described simultaneously in Calvert (1924), and the larvae comparatively recently in Kennedy and White (1979). Although early stadia of the larvae can be difficult to identify, medium to late stadia, exuviae, and adults are unambiguous.

The English name Pygmy Snaketail was assigned in Paulson and Dunkle (1996) and employed by Catling *et al.* (2005) in the most recent Canadian list. The French name *Ophiogomphe de Howe* was recently coined by Paul Catling and Raymond Hutchinson. The name Midget Snaketail has been used by the United States Environmental Protection Agency, and Howe's Midget Snaketail Dragonfly by The World Conservation Union (IUCN, Baillie and Groombridge 1996).

Morphological description

The appearance of the Pygmy Snaketail is typical of the Snaketails except in size and wing markings (Figure 1). It is the smallest of the Snaketails, and one of the smaller dragonflies in North America. Total length is 31-37 mm, and hindwing length 19-21 mm (Tennessee 1993) and abdomen length is 22-24 mm (Needham *et al.* 2000). It is very robust compared to the equally small but very slim species of the Pygmy Clubtails (*Lanthus* Needham) and Least Clubtails (*Stylogomphus* Fraser). The flare at the end of the abdomen is relatively wide for the genus. The female resembles the male except for its thicker abdomen, reduced flare, lack of secondary genitalia, presence of an ovipositor, and different number and shape of the abdominal appendages.



Figure 1. Dorsal and lateral view of the male Pygmy Snaketail.



Figure 2. Dorsal view of exuvia of the Pygmy Snaketail.

The Pygmy Snaketail is dark brown and black, with extensive vivid yellow markings on the dorsal abdomen and bright green on the thorax (Paul Brunelle, pers. obs.). Thoracic markings of teneral are yellow for up to seven days (Kennedy and White 1979). The wings of both sexes are strongly marked basally with a large, transparent yellow-orange field (Paul Brunelle, pers. obs.) which has generally been described as yellow or flavescent (golden), however adult specimens from Maine have yellow-orange markings (Paul Brunelle, pers. obs.). This wing colour pattern is unique in the Clubtails, and rare among North American Odonata. The only similar features are on the Libellulidae species Band-winged Meadowhawk (*Sympetrum semicinctorum* (Say)), Western Meadowhawk (*S. occidentale* Bartenev), some prairie females of the Cherry-faced Meadowhawk (*S. internum* Montgomery, Dunkle 2000), and some females of the Cardinal Meadowhawk from British Columbia (*S. illotum* (Hagen), Paul Catling, pers. comm.).

Larval Pygmy Snaketails (Figure 2) are 19-22.5 mm long (Kennedy and White 1979), and can be discriminated from early stadia of congeners by the absence of dorsal abdominal hooks, although small bumps are present. The lateral spines of abdominal segment 7 are vestigial or absent. Late stadia of Pygmy Snaketail larvae will have wing cases reaching (laterally) the middle of abdominal segment 4 – similarly sized stadia of other Snaketails will have wing cases proportionately much shorter for the same total length.

Detailed descriptive information is available in Bromley (1924, adult female), Calvert (1924, adult male), Kennedy and White (1979, larvae), and Needham *et al.* (2000, adults).

Genetic description

There has been no genetic analysis of individuals across the species range. It is not known if species characteristics differ by population. As the Canadian population is not isolated from the principal eastern North American range, it is likely but unproven that Canadian individuals are not substantially different from those further south.

Designatable units

The entire range of this species is in two areas: the western populations are in Wisconsin, Minnesota and northwestern Ontario, the eastern populations occupy the Appalachian region extending from New Brunswick to South Carolina (Fig. 3). These regions are separated by a distance of approximately at least 700 km (from northern Kentucky to central Wisconsin). Occurrence in northwestern Ontario is considered part of the western group and the populations in New Brunswick represent the northernmost extension of the eastern group. In Canada the occurrences in northwestern Ontario and New Brunswick are widely separate and not likely to be connected across the north based on extensive survey of dragonflies in Ontario and western Quebec and on lack of appropriate habitat (large clean, fast-flowing rivers draining rugged glacial overburden) throughout much of this region. Although this

may seem to warrant two designatable units, the possibility of a connection, at least formerly, led to the interpretation of one designatable unit.

DISTRIBUTION

Global range

See Figure 3 for the global range. Source: revised from Donnelly (2004) and the Odonata Central Distribution Maps website.

The Pygmy Snaketail is largely confined to eastern North America. It is known in a line along the Appalachian Mountains from northern New Brunswick to southeast Tennessee. South of New England the species appears to be confined to the Appalachian Mountains themselves; however, it is found in lowland areas of Massachusetts and Maine up to southwest New Brunswick. The second centre of distribution is just west and south of the Great Lakes in Michigan, Minnesota, and Wisconsin. This suggests that it is a possibility for southwestern Ontario (Catling and Brownell 2000), but likely only for the Renfrew, Nipissing and Algoma districts of the southern Canadian Shield. Seemingly appropriate habitats exist in those districts, but despite extensive recent inventory in Ontario (yielding 60,000 species/site/date records, thousands of which were at rivers in the likely districts), it has not been found (Paul Catling pers. comm.).

Canadian range

The Canadian range includes 12 locations: 11 in New Brunswick (Figure 4a,b) and 1 in Ontario (Fig. 4c). The extent of occurrence is 175,000 km² for all Canada. The area of occupancy is 48 km² using a 2X2 km² grid and 12 km² using a 1X1 km² grid, both calculations based on a very restricted larval habitat.

Northwestern Ontario

On 23 June 2007, Ilka Milne discovered a single exuvium of pygmy snaketail on the Namakan River, Rainy River district, in northwestern Ontario (Fig. 4c). A subsequent survey of the area by I. Milne, M.J. Oldham, and others on 24 June 2008, failed to produce any more adults or exuviae but the habitat was confirmed as suitable. The conditions (extremely high water levels) and timing (very late spring in 2008 and emergence may not have occurred when the survey was undertaken) may have made finding more evidence of a resident population less likely. The specimen collected was initially identified by Ilka Milne and confirmed by Bob Dubois, Ken Tennessen, and Colin Jones and the record is considered reliable. Since the record is based on an exuvium it is considered to represent an established reproducing population.

New Brunswick

See Figure 4a for the range in New Brunswick and the adjacent state of Maine. Source: ADIP data (Atlantic Dragonfly Inventory Program; Paul Brunelle) and MDDS data (Maine Damselfly and Dragonfly Survey; Paul Brunelle) and Figure 4b for occurrence in New Brunswick alone.

Since three locations are on the border with Maine, abundance and distribution in that state are discussed.

The species was first discovered in Canada on June 22, 2002, by Paul Catling (Catling 2002) as emerging teneral on their exuviae and in nearby riparian brush on the banks of the Saint John River at Baker Brook, Madawaska County, New Brunswick (Figures 4a and 4b). Subsequent attempts to rediscover the species at this locale were unsuccessful, although inclement weather was a factor in those site visits. Survey of the Maine shore of the river in this general area during the appropriate period was not successful (Paul Brunelle, pers. obs.).



Figure 3. Global range of the Pygmy Snaketail.

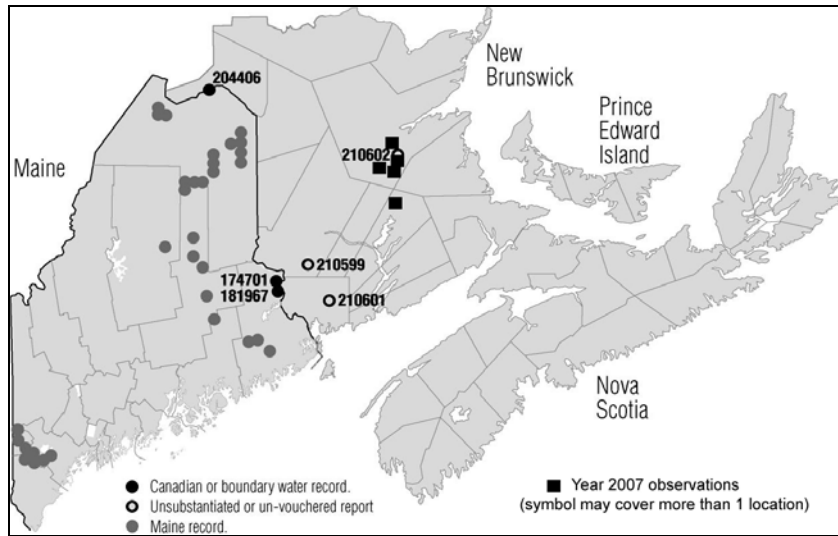


Figure 4a. Range of the Pygmy Snaketail in Maine and New Brunswick. Source: ADIP and MDDS Data, Paul Brunelle, Denis Doucet). The numbers are ADIP and MDDS record numbers referring to specific locations.

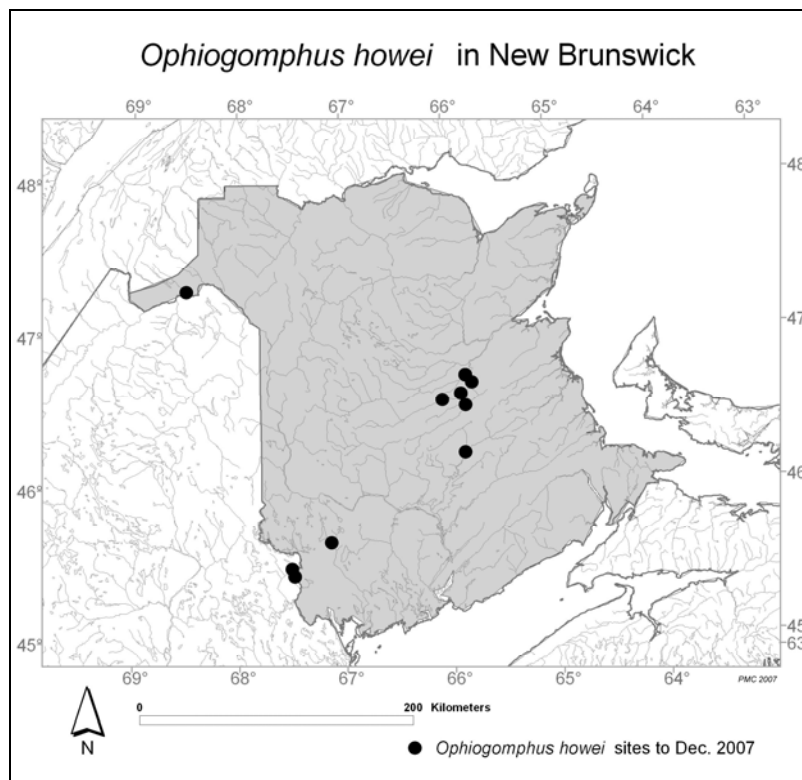


Figure 4b. Locations of populations of *Ophiogomphus howei* in New Brunswick up to Dec. 2007. Each dot represents a single population. The 2008 Doaktown location is not shown on the map, but is part of the cluster of 5 dots in the centre. (Map by P.M. Catling.) One additional location discovered in 2008 is not shown but is part of the main cluster.

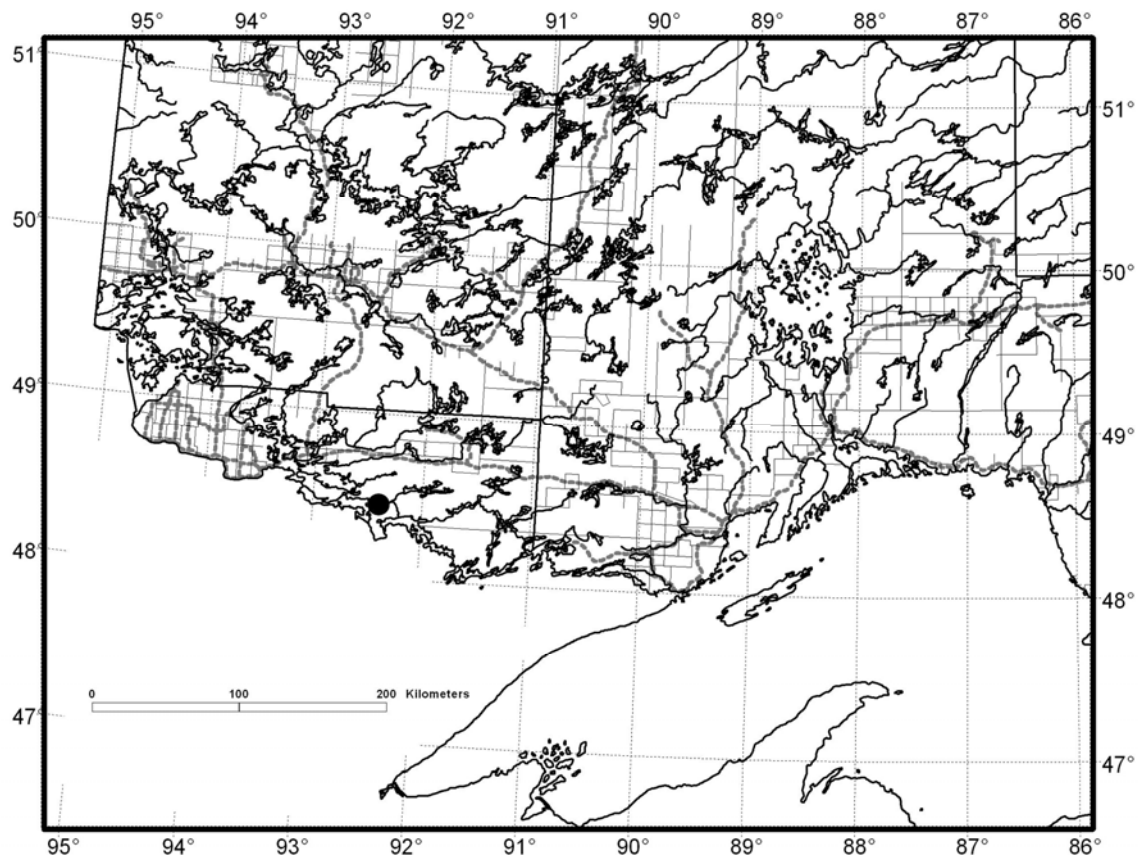


Figure 4c. Location of population of *Ophiogomphus howei* in Ontario. Location of population is indicated by dot. (Map by P.M. Catling)

Recent records from Maine are valuable as they are on the St. Croix River where it is the boundary water with Charlotte County, New Brunswick. The species was recorded from the Maine side of the river on the basis of two exuviae taken on June 22, 1996, by Daniel Boland (MDDS record 181967). On June 30, 2005, exuviae were again taken by Mark Ward at this locale (MDDS 138874), and also at another locale on the river (MDDS 181967). Extensive search efforts on the Canadian shore of this river have to date failed to yield evidence of the species. However, it is very likely that it emerges and flies on the Canadian side.

A credible sighting of an adult was reported at the Magaguadavic River, York County, in southwest New Brunswick, on July 1, 2003, by Dwayne Sabine (ADIP record 210599). Sabine, an experienced dragonfly surveyor, approached to within a metre of a perched dragonfly, close enough to identify it as a female Pygmy Snaketail. This is credible due to the species' unique appearance; however, it does not provide evidence of larval development within the river, though that seems likely.

In 2007, Denis Doucet, Jim Edsall, Paul Brunelle and Gerry Stairs conducted a survey (Doucet 2008) specifically for *O. howei* on the Miramichi River. They located *O. howei* at 6 locations along a 30 km stretch and at a new location on the Salmon River. Since they actually surveyed 61 sites (Natureserve definition of being 1 km apart) on the entire length of the Southwest Miramichi, it is still to be regarded as rare.

From a strictly bioclimatic perspective, based on known geographic occurrence, the species could be found throughout the Maritime Provinces, in the Eastern Townships of Quebec, and in southwestern and southern Ontario. Factors other than climate play a significant role in insect distributions, however, and large areas of what may be perceived as potential range for this species appear to be unoccupied. Based on the extent of dragonfly surveying in these regions (history of interest in Quebec and Ontario, including recent major publications), and relatively extensive survey in the Maritime Provinces (see Search effort), it seems likely that the species is extremely rare, if it occurs at all in these regions.

There is an unsubstantiated report (ADIP record 210601) of exuviae taken downstream of Dwayne Sabine's observation on the Magaguadavic River. There is a further unsubstantiated report of exuviae taken on the Southwest Miramichi River at Blackville, Northumberland County (ADIP 210602). For these two records no voucher specimens are known, and they cannot be accepted without further evidence (Paul Brunelle, pers. obs.).

Search effort

Adult Pygmy Snaketails are very rarely encountered other than as exuviae or teneral adults at emergence. Only five surveyors have encountered mature adults in Maine and New Brunswick; Paul Brunelle, Paul Catling, Denis Doucet, Blair Nikula, and Dwayne Sabine.

Ontario

In the past decade or so there has been considerable odonate survey work in northwestern Ontario. There are several resident experts in the area (e.g. Ilka Milne, Bill Morganstern, Darren Elder). There was a Great Lakes Odonata meeting there in 2005, with experts from throughout the Great Lakes region making observations throughout the area. Mike Oldham has searched for adults and exuviae during at least 6 different trips to the area, including boating on several rivers near the Namakan River. Mike Oldham also searched a number of rivers on the north shore of Lake Superior, as have others (e.g. Rob Foster, Colin Jones, Paul Catling).

The Ontario Odonata database includes 1,092 records (unique species location, date) for Rainy River district, with only the one record of *Ophigomphus howei*. For the adjacent district of Thunder Bay there are 1,353 records. For all Ontario there are 60,000 records.

Much of northwestern Ontario is without suitable habitat for this species, which occurs in large clear, fast-moving rivers with fine gravel substrate. Much of the drainage on the Canadian Shield is impeded, lacking long sections of riffles and many of the rivers are small. Much of western Rainy River is too flat for substantial flow and the rivers are turbid. A few fast-moving sections of these rivers have been searched for dragonfly adults and exuviae with no observations of *Ophiogomphus howei*.

Very few or no other populations are likely to be discovered based on search effort and landscape features.

New Brunswick

There have been substantial lotic exuviae surveys in New Brunswick, and many short and isolated efforts by individuals. The Maine Department of Inland Fisheries and Wildlife has commissioned such surveys since 1995. In addition, survey results for several environmental impact statements in Maine have been documented in the MDDS database. Recent surveys of significance prior to 2007 are:

- (1) Dan Boland and Billie Bradeen, students at University of Maine, Orono, studying under Elizabeth Gibbs, surveyed for Snaketails on the Aroostook River in northeast Maine in the early 1990s, with substantial results for the Pygmy Snaketail, presented in Gibbs *et al.* (2004). Boland went on to survey exuviae throughout Maine for the Maine Department of Inland Fisheries and Wildlife.
- (2) Paul Brunelle conducted an exuviae survey on Canoose Stream in southwest New Brunswick from 1993-1996, with no observations for the Pygmy Snaketail, and on the St. Croix River during the same period and intermittently since until 2006, again with no observations.
- (3) In 2003, the Eel River in mid-western New Brunswick was surveyed intensively by the Atlantic Canada Conservation Data Centre. Although it appeared very similar to the Machias River in Maine, where the Pygmy Snaketail was found, it did not yield the species (Paul Brunelle, pers. obs.).
- (4) In 2004, Paul Brunelle surveyed in Madawaska County, northern New Brunswick, including stations on the Saint John River, with no results for the Pygmy Snaketail.
- (5) Dwayne Sabine had been collecting exuviae intensively on the Saint John River at Fredericton since 2002, with no results for the Pygmy Snaketail.
- (6) In 2006, Paul Brunelle surveyed the St. Croix River intensively on May 13, June 6 to 8, and on August 2 to 4. Larvae were dredged for and also sought by inspecting the substrate under water, and exuviae were collected. Adults were also searched for in mid-river and elsewhere. This river is one of the most heavily surveyed in the region, with 75 visits to date, 44 in which exuviae were collected, and 17 visits in which larvae were sampled. Most of this survey has been done during the presumed emergence and flight period of the Pygmy Snaketail, yet it was not encountered.

The databases of ADIP to 2006 contain sufficient survey visit information to estimate the effort expended prior to 2007 on lotic surveys in New Brunswick. Note that 'field hours' as used below refers to time spent during visits to the particular habitat, not including travel. 'Records' refer to the encounter with a particular species at a particular place on a particular date-different lifestages of the same species are included in the same record, as are multiple voucher specimens.

The following is a précis of the survey efforts expended on lotic habitats in New Brunswick up to 2006. Although the search effort described was not aimed specifically at the Pygmy Snaketail, this does not compromise the results given below since adults of all species are typically netted during surveys-precisely because some species (often the rarest) are difficult to determine on the wing. In addition, surveyors taking exuviae will in most cases act indiscriminately and collect all exuviae encountered as vouchers. Regardless of the general nature of Odonata survey in the Province to date, the Pygmy Snaketail has been a high priority target for dragonfly surveyors in New Brunswick since 1993, due to its known proximity in Maine and status of great conservation concern in that state and elsewhere.

There have been 1,524 visits to running waters sites in the province by surveyors for dragonflies. 783 visits were made during the period spanning from early June to mid-July. This is the period during which Pygmy Snaketails are considered most likely to be found if they have emerged there (Paul Brunelle, pers. obs.). Seventy-four rivers and streams were visited, many at multiple stations and with repeat visits, and about 880 field hours were spent during the presumed flight period. Adult dragonflies were consistently sought during these visits and 2,213 records taken. Exuviae were searched for in 326 of these visits and 631 records were taken, while search for larvae yielded 76 records for 46 visits. Only two visits on two rivers yielded proof of the presence of the Pygmy Snaketail (the St. Croix River records are based on results of Maine survey).

This low level of encounter (0.3% of the 783 lotic visits during the presumed flight period, 0.6% of the 326 visits in which exuviae were sampled) is particularly significant in that Pygmy Snaketail exuviae are as obvious as many other exuviae taken in those surveys, and relatively easy to determine. For example, exuviae of the similarly small Eastern Least Clubtail (*Stylogomphus albistylus* Hagen in Sélys) were taken 27 times during these visits, even though that species' emergence period is about two weeks later than the Pygmy Snaketail's.

Larvae are much more rarely surveyed in the region, and the survey is generally conducted by professional surveyors (whereas exuviae are often collected by ADIP volunteers). There have been 46 visits in which larvae were sampled, at 11 rivers or streams, but Pygmy Snaketail larvae have not been taken in the province. Note that recently acquired information suggests that the comparatively shallow substrate dredging done to date would likely not have yielded Pygmy Snaketail larvae in any event (see Survey techniques below).

A caveat on the preceding statistics are that exuviae or larvae may have been searched for in further visits but that effort, particularly if unsuccessful, may not have been reported to ADIP.

Search effort in adjacent Maine has revealed many populations of the Pygmy Snaketail, suggesting an amount of search effort that is required to find the species when present, and that amount has been exceeded in many parts of the Maritimes without discovery. Paul Brunelle has visited virtually all the Maine locales at which the species has been reported, giving him an accurate impression of the habitats in which it is found.

To summarize: a very substantial search effort in the Maritimes, and elsewhere in eastern Canada, has produced very few records of the Pygmy Snaketail up until 2007, suggesting that it is truly very rare and has a very restricted distribution. The ease of finding exuviae compensates for the difficulty of detecting adults. In the 2007 directed survey involving 61 sites (Natureserve definition of being 1 km apart) on the entire length of the Southwest Miramichi (Doucet 2008), it was only found at 6 contiguous sites on a 30 km section of river and only 20 adults of *O. howei* were observed and 78 exuviae were collected, mostly at two locations. A 2008 survey of the Resticouche, Magaguadivic and St. John Rivers as well as additional area on the Miramichi revealed only one new site on the latter river at the Doaktown Bridge. This survey involved 60 optimal sites and 230 hours and was directed mostly to exuviae.

Although search effort described above is considered a reliable indication of rarity, the fact is that less than 45% of the potential habitat has been subject to a directed search, but the results of that, involving the best habitats, suggests that fewer than 15 additional locations are likely to be found.

Survey techniques

Survey techniques have primarily involved the search for adults and exuviae by experienced odonatists. Research during the preparation of the draft status report revealed critical unpublished information regarding the behaviour of Pygmy Snaketail larvae which does much to explain the lack of success in finding them in the past. Thomas Donnelly (pers. comm.) has seen the larvae burrow to a depth of approximately 20 cm in fine substrate (Figure 7) during the day, and believes that they may drift with the current at night.

Future survey for this species in New Brunswick should focus on exuviae collection, with adult collection engaged in opportunistically, but drift nets and substrate excavation should be used as well if resources allow for it.

HABITAT

Habitat requirements

Habitat requirements in Odonata are largely those of the larvae, although threats to surrounding forest cover may impact adult viability prior to ovipositing, as the adults are believed to spend the bulk of their flight in those forests.

The Pygmy Snaketail is a species of larger, swiftly flowing, and moderate gradient rivers with significant areas of fine sand or pea gravel substrate (Figures 5, 6, and 7). Tennesen (1993) and Dunkle (2000) describe the habitat as "*Big, clear, strongly flowing, clean rivers with gravel/sand bottoms, rarely small rivers.*" Kennedy and White (1979) reported similar characteristics for the New River in North Carolina and Virginia ("*Nymphs were found in sand and gravel in swiftly flowing water.*"), and the Susquehanna River in Pennsylvania. For the New River they noted that dissolved oxygen was always near the saturation point. Such habitats are linear, though they may be unsuitable in some segments due to local flow and substrate characteristics. Even within river segments of the appropriate characteristics, the depositional shore substrate may be unsuitable for the Pygmy Snaketail.

It is notably not found in smaller rivers (less than 10 m wide), as indicated for example by the extensive larval, emergence, and exuviae surveys at Canoose Stream, Charlotte County, New Brunswick, 45.3667°N, -67.35°W (a tributary of the St. Croix River). This survey did not yield the species, though its congener the Extra-striped Snaketail (*O. anomalus* Harvey, often considered an indicator species for the Pygmy Snaketail) is relatively common on that stream (Paul Brunelle, pers. obs.). The Pygmy Snaketail is not likely to be found in high-gradient streams ('trout streams'), even those of comparatively large size, unless there are substantial sections of low-gradient stream bed which can retain the fine substrate which appears to be a larval requirement.

Based on rivers where the Pygmy Snaketail has been encountered in Maine (Paul Brunelle, pers. obs.), the species is likely intolerant of eutrophication, perhaps even of mild increases in nutrients, and of interference with the flow of the river. It has not been found in eutrophic waters or those where flow has been substantially modified. Although present along considerable lengths of the Aroostook River in Maine it is apparently absent from the Canadian course of that river below a dam, although the Extra-striped Snaketail is present (Paul Catling, pers. comm.). A five-year intensive exuviae survey of a 200 m stretch of the Saint John River at Fredericton by Dwayne L. Sabine has failed to discover the species there, although a diverse list of lotic Gomphidae have been taken, some of which are also considered sensitive to aquatic habitat values (Dwayne Sabine, pers. comm.). At this point, the river is below the large Mactaquac Dam, but still has perceptible current, runs clear, and in other respects appears appropriate for the Pygmy Snaketail.



Figure 5. Typical habitat of the Pygmy Snaketail on the Saint John River. Note that what appears to be the far bank is actually the shore of a large mid-river island. The river is approximately twice this width in this area.

Most river systems in the province have been surveyed for exuviae to some extent during the appropriate date range. During this work, the often associated Extra-striped Snaketail (*O. anomalus*) has been recorded from 8 rivers or large streams; Canoose Stream, Digdeguash River, Halls Brook, Magaguadavic River*, Saint John River*, South Branch Oromocto River, Southwest Miramichi River, and St. Croix River*. In all but the Halls Brook case, breeding presence of the Extra-striped Snaketail has been confirmed, generally with exuviae collection, in some cases by observation of emergence. Of the 32 rivers from which *O. anomalus* has been recorded in Maine

and New Brunswick, only 11 also yielded the Pygmy Snaketail. By this indication, the three known rivers (*) for the Pygmy Snaketail in New Brunswick are in a similar proportion to that of Maine and New Brunswick. Similar proportions of common encounters also apply to the Broadtailed Shadowdragon (*Neurocordulia michaeli*) in the region (Paul Brunelle, pers. obs., ADIP and MDDS data). To summarize, it is not clear exactly what determines the presence of Pygmy Snaketail, but places where populations can survive are apparently rare, and ecological factors other than those summarized through habitat description likely play an important role.

Habitat trends

There is no firm information on habitat trends. There appears to have been no recent decline in the quality of the aquatic or terrestrial habitats associated with the three rivers in New Brunswick known to harbour the Pygmy Snaketail, nor to the river in Ontario. However, they will only be viable for the species if they continue to be protected from threats (see Limiting factors and threats), and the species is likely vulnerable to changes in water quality.

Habitat protection/ownership

Of the three rivers with confirmed records of the Pygmy Snaketail in New Brunswick, only the St. Croix River is protected to some extent by the St. Croix International Waterway Commission, which has the mandate to administer a heritage management plan for the boundary corridor.

The other two rivers, the Saint John River above Grand Falls in northern New Brunswick, and the Magaguadavic River in southwest New Brunswick, have no formal protection and the former is largely surrounded by agricultural, suburban, and urban landscape. However, large portions of both of the St. John and Magaguadavic River are forested.

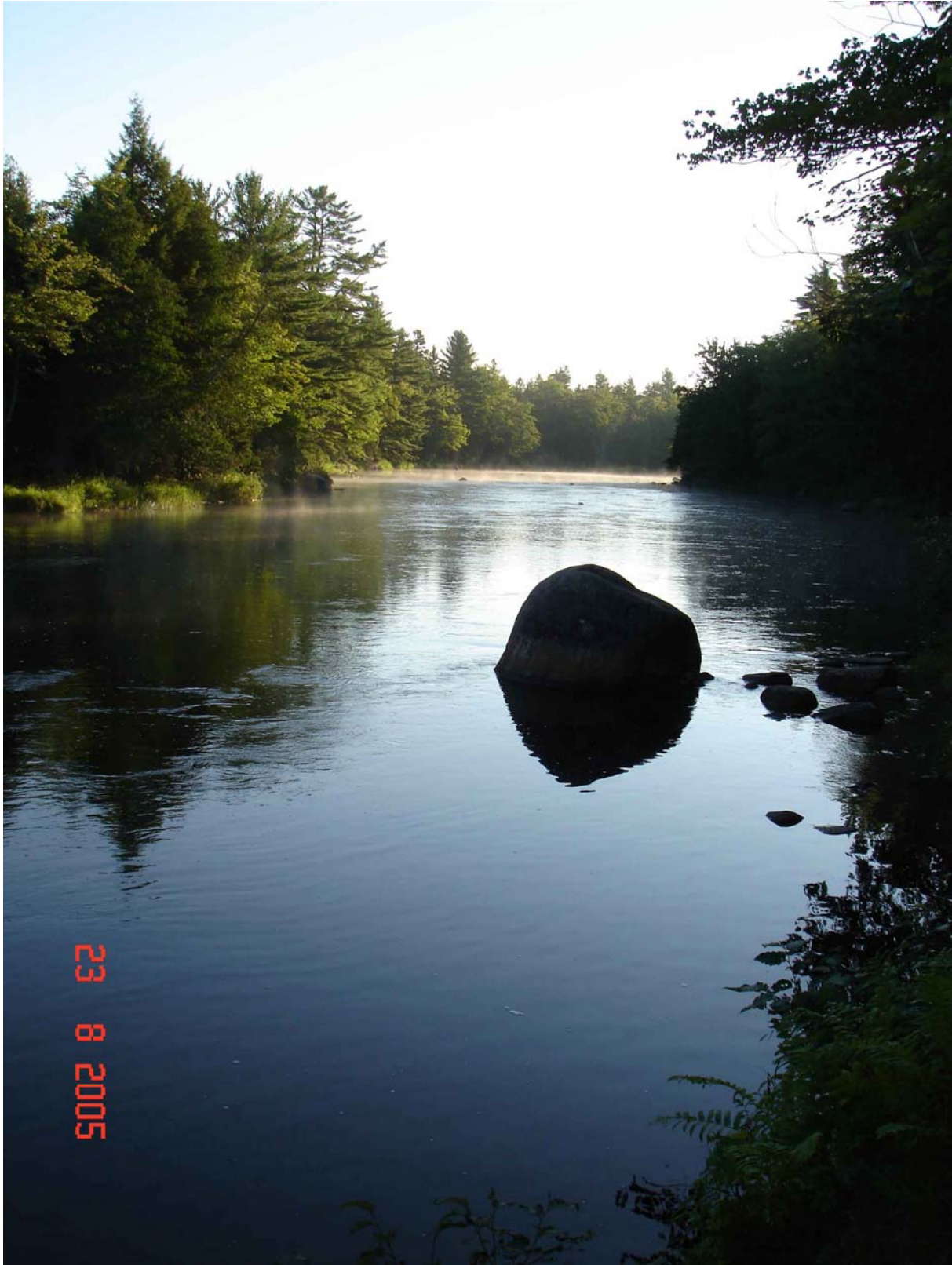


Figure 6. Typical habitat of the Pygmy Snaketail, St. Croix River.

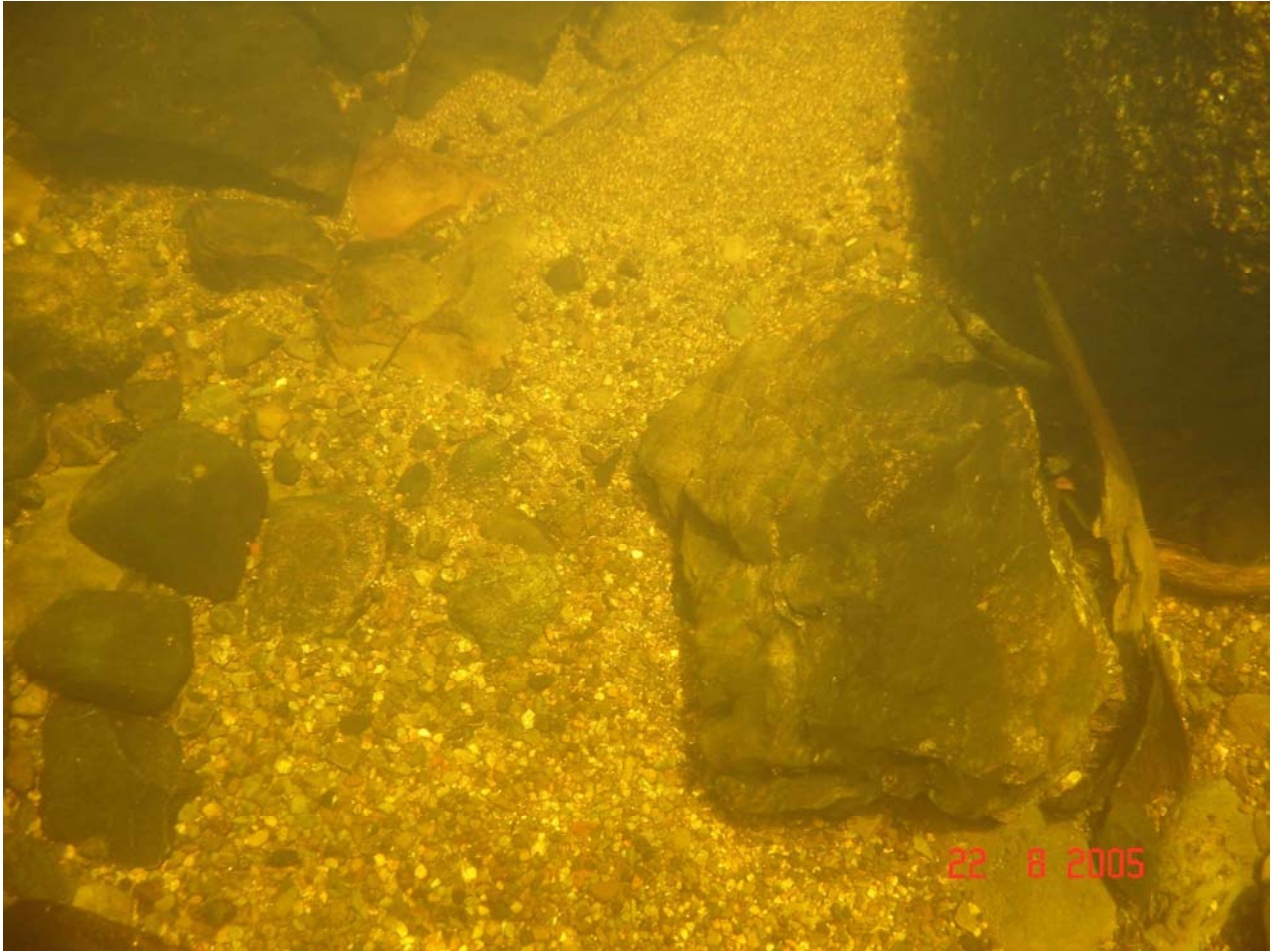


Figure 7. Supposed substrate of the Pygmy Snaketail larvae. The larvae burrow in the pea-sized gravel.

BIOLOGY

Life cycle and reproduction

As with all Clubtails the eggs are laid into water exophytically (outside of plants) by dipping the end of the abdomen to release them. In one observed instance this was done in the current in the middle of the river (Thomas Donnelly, pers. comm.), and in another in the slower but still active current margins of a run of even flow (Paul Brunelle, pers. obs.). Presumably these eggs sink to the bottom while carried along by the current, and development of the larvae is on or inside the substrate.

Larvae take at least two years to develop to emergence (Kennedy and White 1979), and possibly longer. In the Pygmy Snaketail, the larvae were discovered by William Kennedy (1979) to be deep burrowers (20 cm) during the day (Thomas Donnelly, pers. comm.) coming to the surface and drifting with the current at night, with peak abundance of drift at about 2:00am EST (1:00am AST in New Brunswick). The absence of collected larvae in Maine and New Brunswick substantiates this. Paul Brunelle (pers. obs.) has never taken larvae in extensive substrate dredging in rivers including the St. Croix River, and no larvae were taken in the equally extensive sampling which is included in Gibbs *et al.* (2004).

Figure 8 gives emergence dates known for Maine and New Brunswick. It is likely that emergence begins with drifting of the larvae, and hence larvae leaving the water to emerge will be concentrated where strong current slows abruptly ('settle-points', Paul Brunelle, pers. obs.). Typical settle-points will be the head of pools into which rapids are emptying, and generally below structures along the erosional banks of the rivers. Gibbs *et al.* (2004) suggest that the Pygmy Snaketail emerges synchronously towards the end of the emergence of the congeners Extra-striped Snaketail (*O. anomalus* Harvey), Riffle Snaketail (*O. carolus* Needham), and Maine Snaketail (*O. mainensis* Packard), and more or less during the same period as the Brook Snaketail (*O. aspersus* Morse).

Exuviae are usually taken on erosional banks near where the current is strong, suggesting that they either live in the fast but even current adjacent to those banks, or that they drift prior to emerging, in which case they would tend to end up at those banks. They generally emerge close to the water's edge.

Following emergence, the teneral fly from the river for an extended period of maturation. While most Odonata species return frequently to rivers to establish territories and breed, the Pygmy Snaketail seems to spend little time at its larval waters. It is likely that it spends the bulk of its adult life in the surrounding forest, usually in the canopy, where virtually no observation has been done. Kennedy and White (1979) noted that they flew high in the trees in the late afternoon until dusk. Of the few encounters with adults on record, one was at ground level in brush marginal to the river, several on brush not far from the river, several on bushes in fields a substantial distance from any potential larval habitat (T.W. Donnelly and J.J. Daigle, pers. comm.), and several at water.

The most detailed report we have of an encounter with adult Pygmy Snaketails suggests why adults of the species are so rarely collected, and it may be useful to future surveyors. In essence, it shows that females spend only a brief period at the rivers for laying, then flee upwards to the forest canopy to escape the attentions of the males, or are carried away into the forest if the males catch them. Males patrol low and fast over the water surface in company with other similar dragonflies, and are exceedingly hard to net.

Figure 5A: Flight of the Pygmy Snaketail in New Brunswick, Canada.

	Earliest Flight ^B	May ^A					June					July					Rec. No. ^C	Latest Flight ^B	
		A	B	C	D	E	A	B	C	D	E	A	B	C	D	E			
♂ Adults	June 22											1		1				2	July 1
Exuviae																			

Note: Numbers given in the columns are of records (species/site/date), not the number of insects encountered.

The thick grey bars are the flight period, based on information in hand. Exuviae records can indicate start of the flight period, but not extend it past the last encounter with adults.

Unsubstantiated records are not included.

A Subdivisions of the month. Each month is divided into five units ('quints') of six days, except for quint E, which is seven days long in May and July.

B Earliest and latest flight recorded in New Brunswick.

C Total record number. This may differ from the sum of the columns due to multiple lifestage records.

D In each quint the number of records of all lifestages are given, adult records above, exuviae below.

Figure 5B: Flight of the Pygmy Snaketail in Maine, USA.

	Earliest Flight	May					June					July					Rec. No.	Latest Flight			
		A	B	C	D	E	A	B	C	D	E	A	B	C	D	E					
Adults	May 25											1	8	2	2	1				80	July 7
Exuviae						1 ^E	1	23	24	9	3	1	1								

Notes as with 5A, except:

E The May exuvia record is below the area of Maine which is relevant to Canadian behaviour of the species.

Figure 5C: Flight of the Pygmy Snaketail in Acadia.

	Earliest Flight	May					June					July					Rec. No.	Latest Flight			
		A	B	C	D	E	A	B	C	D	E	A	B	C	D	E					
All Acadia Adults	May 25											1	9	2	3	1				82	July 7
Exuviae						1	1	25	24	9	3	1	1								
47 to 48°N+ Adults	June 22											1								3	June 22
Exuviae												1	1	1							
46 to 47°N Adults	June 13											1	6		1	1				56	July 7
Exuviae												22	24	4	2						
45 to 46°N Adults	June 17														1					11	July 1
Exuviae												4	4		1	1					
44 to 45°N Adults	June 17											2	2							9	June 26
Exuviae												2	3	1							
43 to 44°N Adults	May 25														1					3	July 1
Exuviae						1	1														

Figure 5D: Reproductive Period of the Pygmy Snaketail in Acadia.

	Earliest Flight	May					June					July					Rec. No.	Latest Flight			
		A	B	C	D	E	A	B	C	D	E	A	B	C	D	E					
Emergence	June 19													8		1				9	July 1
Mating	June 20													2						2	June 20
Laying	June 20													2						2	June 20

Notes as with 5A.

Figure 8. Flight and reproductive periods of the Pygmy Snaketail in Maine and New Brunswick.

Adult activity period

Figure 8 gives the known flight period for Maine and New Brunswick. Flight periods in Odonata are largely dependent upon seasonal temperatures, closely related to latitude, elevation (not particularly important in Maine and New Brunswick), and proximity to the ocean (not particularly important with respect to rivers flowing from inland in Maine and New Brunswick). Aside from in the extreme southwest below 44°N, conditions in Maine are very similar to those in New Brunswick and results from survey in most of Maine can therefore be used as the basis for assessing probable distribution and planning survey in New Brunswick. Data for Maine is from MDDS (Paul Brunelle).

The Pygmy Snaketail flies in early to mid-summer. After emergence, adults will live until taken by a predator (death through other natural causes seems to be rare in Odonata, Paul Brunelle, pers. obs.). Usually with dragonflies the bulk of the individuals will be gone in a month or so, but rare individuals of the early summer emerging species may last as long as three months. It is a reasonable assumption that few if any of the earlier emerging species survive long enough to be killed by the first frosts. Due to the very small number of encounters with adults of the Pygmy Snaketail, there are not enough data to speculate on the reproduction period, although what little we know is also given in Figure 8.

Food resources

As with other stream gomphids, Pygmy Snaketail larvae likely eat whatever small creatures are also present in their substrate habitat, potentially including larval fish and conspecifics, and other invertebrates. Kennedy and White (1979) recorded water mites (Arachnida), mayflies (Ephemeroptera), and midge larvae ((Diptera) from the foregut of Pygmy Snaketail larvae. The burrowing behaviour of the larvae suggests that there may be some specialization in prey. Little is known of the food preferences of Pygmy Snaketail adults. Presumably they feed on whatever flying insect species is present, as do most Odonata species. They have not been reported to glean from solid surfaces.

Dispersal/migration

The Pygmy Snaketail is not a migratory species. Although dispersal is more likely along the river corridors and small running waters of its catchments, the forest-dwelling nature of the species suggests that it is capable of crossing the intervals between catchments. Following its initial discovery in Canada in 2002, there was some speculation about whether or not it may be vagrant, but in 2002 there was evidence of local development, the recently emerged adults still attached to the larval skins. In general it is considered a localized species that does not wander more than a few km from the larval habitat.

Interspecific interactions

Although the Pygmy Snaketail is a small species, it may actively defend territory. A male has been seen pursuing and harassing the Illinois River Cruiser (*Macromia illinoensis* ssp. *illinoensis* Walsh), one of the larger species to fly along rivers (Paul Brunelle, pers. obs.). It is likely, however, that the Pygmy Snaketail occasionally falls prey to the ubiquitous Dragonhunter (*Hagenius brevistylus* Sélys), a large dragonfly which feeds predominantly on other Odonata, and which may be its principal at-water predator. Other large predacious insects may also take the Pygmy Snaketail; some wasps (Hymenoptera) and Robber Flies (Diptera) appear to be large and aggressive enough to do so. Insectivorous birds such as swallows are a common predator on Snaketail dragonflies, and would likely take the Pygmy Snaketail when present (Paul Catling, pers. comm.). It seems likely that most adult mortality is from insectivorous birds feeding in the forest canopy.

Adaptability

With its apparent ecological limitation and association with pristine conditions, it seems unlikely that the Pygmy Snaketail is capable of making sufficient and timely adjustment to enable it to survive substantial habitat alteration.

POPULATION SIZES AND TRENDS

Abundance, fluctuations and trends

Population size is unknown, but several hundreds of individuals are likely necessary to sustain a population, based on observations of the populations of other stream-dwelling dragonflies (Paul Brunelle, pers. obs.). The data in hand is insufficient to speculate on fluctuation of populations. Given the relatively good condition of the Saint John River at Baker Brook where the Pygmy Snaketail was encountered, and the lack of recent heavy impact on rivers in the region, it is likely but unproven that the Canadian population is stable at its current level.

Rescue effect

Although the nearest site in Minnesota is only 90 km distant from the Ontario site, and sites in Maine are approximately 70 km from New Brunswick locations, this is further than adults are believed to wander. As far as is known, the adults generally do not wander far from the rivers where they have developed as larvae. Snaketail species are generally closely associated with larval sites, unlike some other genera of dragonflies that wander widely. Considering these aspects, and without more information on dispersal of adults, a rescue from outside populations is possible but cannot be considered likely.

The strain on natural aquatic habitats increases to the south with higher human populations and increased industrialization, and it may be that Canadian populations are at lesser risk. The species is listed with statuses of conservation concern for most states adjacent to Canada. This suggests that re-colonization of Canadian extirpations is unlikely. In Maine, the species is currently listed as Threatened, but proposed for listing at Special Concern, "*because of its limited distribution and global rarity*" (deMaynadier, 2006). The species is known from 22 locations, but on only 11 rivers in Maine, in spite of considerable survey effort for exuviae on 90 rivers and streams in the state (MDDS Data, Paul Brunelle). As Maine and New Brunswick have very similar landforms and land use practices, it seems likely that any broad threat to Pygmy Snaketail habitat will be shared by province and state. In addition, the Saint John River flows from northern Maine into northern New Brunswick-impact on this river within Maine will possibly extend into its Canadian sections.

LIMITING FACTORS AND THREATS

There are only a few obvious and immediate anthropogenic threats to individual Pygmy Snaketails. Road-kill, which can be very significant in some dragonfly species, seems unlikely to be a serious factor for the Pygmy Snaketail due to its adult behaviour. It is not notably a percher on the ground, hence not on roads, and it does not patrol along openings in the forest, therefore not along roads. However, teneral leaving the water during the emergence period might suffer high mortality in crossing roads following the bank of the river or nearby, and along which vehicles travel at more than 50 km/hr. This speed seems to represent the upper boundary of the ability of dragonflies to get out of the way of approaching vehicles. The amount of traffic and the nature of the road is significant. Well-constructed unpaved woodland roads and secondary highways, which allow high speed but have narrow rights of way, seem particularly dangerous for dragonflies. Larger highways with wide rights of way are much less so (Paul Brunelle, pers. obs., based on six years traveling with a net on the front of a vehicle).

Another direct threat is interference with emergence by recreational use of waters and construction. Any boat or vehicle which casts a wake during the hours of emergence cannot fail to kill emerging specimens. Even landing canoes, wading and shore-walking at the emergence site is potentially damaging to the emerging population during the short (~4-day) emergence period. On the Saint John River at Bakers Brook a threat to larvae and emergents is the driving of heavy agricultural machinery through the river to work on the large island in mid-stream. Although this equipment undoubtedly damages the substrate where it passes, and causes a heavy surge along the shore, the area influenced is within a constant path, small in area compared to the overall potential larval-supporting area of this wide, shallow river; and the activity has been going on for many decades.

Anthropogenic habitat change represents the greatest potential threat to the species, and larger rivers are especially susceptible to environmental damage despite regulations. Some of the potential threats to this habitat type are summarized below.

The greatest perceived threat to populations is the impoundment of running waters. Kennedy and White (1979) noted that it "*apparently cannot breed in conditions found below dams.*" Damming likely had a profound influence on the distribution and abundance of the species in the 1800s and early 1900s when that practice was in vogue throughout northeast North America for industrial and hydroelectric purposes. Dams constructed by beavers, whose population has been allowed to increase by the reduction of predators, represent a decided threat to the smaller running waters habitats and some rare Odonata which inhabit them; however, the Pygmy Snaketail is not known to inhabit the smaller running waters. Although construction of new dams has declined over the last several decades, it is anticipated that the increasing cost of oil and windpower hydro (which can change water levels as much as 1.5 m in a day) may pose serious threats. The Ontario population may be negatively impacted by hydroelectric construction planned for the Namakan River.

Pollution is a potential threat, particularly by broadcast pesticides used in agriculture or forestry management; and most particularly by those used for the control of aquatic larvae of biting insects. As Odonata rank very high in the invertebrate foodchain, they will take up persistent insecticides, potentially to a debilitating or lethal level. Toxic chemical spills are a distinct threat, particularly where road and rail corridors are adjacent to the river. Eutrophication due to excessive nutrient input from sewage, or sedimentation due to agricultural or forestry run-off are distinct threats to larval habitat (Jerrell Daigle, pers. comm., considers an unspoiled catchment a requirement for the species; however, this is relative-forestry is prevalent throughout the catchments of our known populations). Clearing and insecticidal spraying of forests surrounding their rivers may exert a negative impact on adult populations, which are thought to spend much of their time in the forest canopy.

Invasive species may represent a threat either directly to the species, or indirectly by alteration of the biotic composition of the habitat. Invasive aquatic plants are currently a concern in the region; they will invade a water body and grow to a density which seriously influences the water quality, followed by a die-off which can yield lethal water quality characteristics. Distributed principally by recreational watercraft, and possibly waterfowl, and hence able to cross catchments, these plants are largely still-water species; however, the trend should be monitored, and the application of herbicides for the control of these invasive species in the catchment should also be considered very carefully.

The deliberate or inadvertent introduction of other aquatic organisms may represent a threat to the Pygmy Snaketail, and we have very little detailed knowledge of the impacts of these invasions. It seems very unlikely that introduced Odonata species will be viable. These introductions are an increasing trend in the northeast in a shortsighted attempt to control mosquito populations, concern over which has intensified since West Nile Virus became a public health issue. Typically these introductions are of still-water species into standing rather than running waters.

Crayfish (Decapoda, Cambaridae) species have been illegally introduced in the region for recreational fisheries purposes. They certainly consume surface-dwelling larvae (Paul Brunelle, pers. obs., based on aquarium and in situ studies of the Spinycheek Crayfish, *Orconectes limosa* (Rafinesque)) from the St. Croix River. While the Spinycheek Crayfish is not a burrower (a lurker under substrate structures, with some tendency to excavate), and hence less of a threat to the deep-burrowing Pygmy Snaketail than to its largely surface-dwelling congeners, there are deep-burrowing Crayfish species which might be a significant threat if introduced. In addition, when the larvae emerge from the substrate to drift at night, and to travel to the shore to emerge, they must run the gauntlet of Crayfish at the substrate surface. In New Brunswick two other species of crayfish are recorded from the northern areas and possibly from the Saint John River; the Virile Crayfish (*Orconectes virilis* (Hagen)), and the Appalachian Brook Crayfish (*Cambarus bartoni* (Fabricius)). While the latter is indigenous and similar in behaviour to the Spinycheek Crayfish, the behaviour of the Virile Crayfish is not well known (Dubé and Desroches 2007).

Fish species are also illegally introduced for recreational fishing. In spite of the illegality this continues to occur as is shown by the spread of the Chain Pickerel (*Esox niger*, Lesueur) in Nova Scotia (Paul Brunelle, pers. obs.). In the St. Croix River, Smallmouth Bass (*Micropterus dolomieu* Lacépède) introduced historically by the government are voracious predators on the benthos (Paul Brunelle, pers. obs. in situ). Again, they possibly do not represent a constant threat to larval Pygmy Snaketails, but they may have a significant impact when the Pygmy Snaketail larvae emerge from the substrate for nocturnal drifting or to become adults, as the bass feed at night (John Gilhen, pers. comm.). The Muskellunge (*Esox masquinongy* Mitchill) has been officially introduced in Quebec within the Saint John River catchment (pers. obs.). From there it colonized that river and its main tributaries in northwest Maine, where it is considered to be having a serious impact on the fish species. There appears to be no impediment to it reaching the Saint John River in New Brunswick as far south as Grand Falls, and it already occurs along part of this stretch. Although this is a largely still-water species, it can inhabit rivers and is a voracious predator.

SPECIAL SIGNIFICANCE OF THE SPECIES

The Pygmy Snaketail's presence is indicative of reasonably uncompromised running waters habitats. Since it can act as an indicator species, other unusual and significant species will likely occur where it is found. It is considered rare or at risk and a protection priority throughout its range in North America. This species reaches its northeastern northern extreme in Canada. Its global viability may come to be dependent upon the lower level of anthropogenic impact on Canadian waters, relative to catchments to the south.

Organized and widespread inventory of Odonata has occurred over the past few decades in Maine and New Brunswick (see Search effort), and as a result of this work, the Pygmy Snaketail is believed to be very rare in this region.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

Of the confirmed Pygmy Snaketail occurrences in Canada, the St. Croix River in southwest New Brunswick is protected by the St. Croix International Waterway Commission. The Saint John River in northern New Brunswick and the Magaguadavic River in the southwest have no formal protection. Much of the Miramichi River is protected for Salmon fishing.

Status designations for the Pygmy Snaketail reflect its rarity overall. The World Conservation Union (IUCN) listed the Pygmy Snaketail as Vulnerable (Baillie & Groombridge 1996). NatureServe has listed the species globally at G3, and nationally for the United States at N3 (NatureServe website). This status level of 3 indicates rarity ('uncommon') throughout its known range. NatureServe has not yet assessed the species for Canada; however, it has been assigned the status of S1 ('endangered') for the Province of New Brunswick. The National General Status review of 2002 assigned the species status 2 (may be at risk) for both Canada and New Brunswick.

TECHNICAL SUMMARY

Genus species

Ophiogomphus howei

Pygmy Snaketail

Ophiogomphe de Howe

Range of Occurrence in Canada: Ontario and New Brunswick

Demographic Information

Generation time (average age of parents in the population)	2 yrs
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 or 5 years, or 3 or 2 generations].	Unknown
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 or 5 years, or 3 or 2 generations].	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 or 5 years, or 3 or 2 generations] period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible?	Not applicable
Are the causes of the decline understood?	Not applicable
Have the causes of the decline ceased?	Not applicable
[Observed, inferred, or projected] trend in number of populations	Unknown
Are there extreme fluctuations in number of mature individuals?	Unknown
Are there extreme fluctuations in number of populations?	Unknown

Extent and Area Information

Estimated extent of occurrence	Approx. 175,000 km ² .
[Observed, inferred, or projected] trend in extent of occurrence	Unknown
Are there extreme fluctuations in extent of occurrence?	Unknown
Index of area of occupancy (IOA) 48 km ² using a 2X2 km ² grid and 12 km ² using a 1X1 km ² grid, both calculations based on a very restricted larval habitat.	12 - 48 km ²
[Observed, inferred, or projected] trend in area of occupancy	Unknown
Are there extreme fluctuations in area of occupancy?	Unknown
Is the total population severely fragmented?	YES
Number of current locations	12
Trend in number of locations	Stable
Are there extreme fluctuations in number of locations?	Unknown
Trend in area and quality of habitat	Decline in area and quality anticipated at one important location, otherwise stable

Number of mature individuals in each population

Population - No reliable population estimates	N Mature Individuals
	Unknown
Total	
Number of populations (locations)	12

Quantitative Analysis

	None
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Threats (actual or imminent, to populations or habitats)

Boat wash, pollution, eutrophication, invasive species.

Rescue Effect (immigration from an outside source)

Status of outside population(s)?

USA: N3, of conservation concern throughout.
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Is immigration known?	No
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Would immigrants be adapted to survive in Canada?	Probably
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Is there sufficient habitat for immigrants in Canada?	Yes
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Is rescue from outside populations likely?	Possibly
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Current Status

COSEWIC: Special Concern, November 2008

Recommended Status and Reasons for Designation

Recommended Status:	Alpha-numeric code:
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Special Concern	N/A
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Reasons for designation:

This globally rare species is known from few locations and has a specialized and restricted habitat with low population numbers and one significant site is threatened.

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable
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Criterion B (Small Distribution Range and Decline or Fluctuation): The distribution is fragmented but there is insufficient evidence of decline and/or fluctuation, and projected decline involves one of 12 locations.
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Criterion C (Small and Declining Number of Mature Individuals): No evidence of decline

Criterion D (Very Small Population or Restricted Distribution): Although the area of occupancy is small and there are few locations, the species is not expected to become highly endangered or extirpated within a short time period.

Criterion E (Quantitative Analysis): Not applicable
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ACKNOWLEDGEMENTS AND AUTHORITIES CONSULTED

The report writer, Paul M. Brunelle, would like to acknowledge the assistance of Dr. Paul Catling, Dr. Thomas Donnelly, Jerrell Daigle, Karen Gaines, Dr. Donna Giberson, John Gilhen, Blair Nikula, Paul Novak, Dwayne Sabine, Dr. Maureen Toner, Dr. Harold White; and the many volunteer surveyors of ADIP and MDDS.

Valuable comments on a later version were received from Michael Oldham, Shelley Pardy, Daniel Banville, Brian Skinner, Elsa Gagnon and Maureen Toner. Denis Doucet provided information on his exceptional survey of the Miramichi River in 2007, and on other rivers in 2008. The report was updated with regard to Ontario and recent work in NB by Paul Catling, Paul Brunelle, Colin Jones, and Rob Cannings.

INFORMATION SOURCES

Websites

All websites accessed on March 9, 2007.

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Massachusetts Natural Heritage & Endangered Species Program.
<http://www.mass.gov/dfwele/dfw/nhosp/nhspecies.htm>

Michigan Natural Features Inventory.
<http://web4.msue.msu.edu/mnfi/data/specialanimals.cfm>

Minnesota Department of Natural Resources.
<http://www.dnr.state.mn.us/ets/index.html>

NatureServe.
<http://www.natureserve.org/explorer/servlet/NatureServe>

New York State Department of Environmental Conservation.
<http://www.dec.state.ny.us/website/dfwmr/wildlife/endspec/etsclist.html>

North Carolina Natural Heritage Program.
<http://www.ncnhp.org/Images/Other%20Publications/2004%20Rare%20Animal%20List.pdf>

Odonata Central Distribution Maps.
<http://odonatacentral.bfl.utexas.edu/gmap/>

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<http://www.naturalheritage.state.pa.us/invertebrates.aspx>

Tennessee Natural Heritage Program.
http://www.state.tn.us/environment/na/pdf/animal_list_2004.pdf

Virginia Department of Game and Inland Fisheries.
<http://165.176.249.121/wildlife/virginiatescspecies.pdf>

United States Fish & Wildlife.
<http://www.dec.state.ny.us/website/regs/part182.html>

Wisconsin Department of Natural Resources.
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BIOGRAPHICAL SUMMARY OF REPORT WRITER

Paul Michael Brunelle has been studying the Odonata of Atlantic Canada and northern New England since 1987. He has authored a number of papers on the subject, and has proposed list statuses for Canada (NatureServe), all the Maritime provinces, and for the State of Maine. He was invited to participate in the 2002 Odonata assessment for National General Status. Brunelle established the Atlantic Dragonfly Inventory Program (ADIP) volunteer survey in the early 1990s. In 1997 he was retained by the State of Maine to plan the Maine Damselfly and Dragonfly Survey (MDDS), prepare its publications, give volunteer briefing seminars, and determine and input specimens. He was also retained to survey for rare Odonata species in the state. In 2000, Brunelle completed the description of the Broadtailed Shadowdragon (*Neurocordulia michaeli* Brunelle) from New Brunswick. Brunelle has entered more than 51,000 records in the ADIP/MDDS databases since their inception; more than 9,000 of which are from his own field work.

COLLECTIONS EXAMINED

The following Canadian collections and those of nearby states have been examined. Those containing specimens of the Pygmy Snaketail are indicated.

A.D. Picket Entomological Museum, Nova Scotia Agricultural College, Truro, Nova Scotia.

Atlantic Dragonfly Inventory Program Data (ADIP); specimens deposited in the New Brunswick Museum, the Nova Scotia Museum, or remaining with the volunteers pending deposit.

Brunelle Synoptic Collection, Halifax, Nova Scotia; pending deposit.

Canadian National Collection of Insects, Ottawa, Ontario (CNCI); only Paul Catling specimens of the Pygmy Snaketail (deposited after Brunelle inventory).

Maine Department of Inland Fisheries and Wildlife; Maine Damselfly and Dragonfly Survey Data (MDDS); specimens are currently with Brunelle; including specimens taken under contracted survey for the Department. These specimens will be deposited with the Maine State Museum, Augusta, Maine.

New Brunswick Museum, Saint John, New Brunswick.

Nova Scotia Museum of Natural History, Halifax, Nova Scotia.

Nova Scotia Department of Natural Resources, Baddeck, Nova Scotia.

Nova Scotia Department of Natural Resources Insectary, Shubenacadie, Nova Scotia.

Royal Ontario Museum, Toronto, Ontario.

University of Maine, Orono, Maine; the Pygmy Snaketail specimens of Daniel Boland and Billie Bradeen are deposited here, except for those taken by Boland under contract to MDIFW, which are deposited with the Maine Damselfly and Dragonfly Survey material.

University of Massachusetts, Amherst, Massachusetts.

University of New Hampshire, Durham, New Hampshire.